APPENDIX I

CLIMATE
SEVIER RIVER BASIN, UTAH

United States Department of Agriculture
Economic Research Service • Forest Service • Soil Conservation Service

May 1969

APPENDIX I

CLIMATE

SEVIER RIVER BASIN, UTAH

United States Department of Agriculture
Economic Research Service
Forest Service
Soil Conservation Service

May 1969

TABLE OF CONTENTS

TABLES

FIGURES

MAPS

Chapter I. INTRODUCTION

The climate of the Sevier River Basin is influenced by the distance from the equator, elevation above sea level, location relative to storm paths and distance from principal sources of moisture. Of these, the precipitation factors are the most variable while the thermal conditions are more stable.

Essentially, there are two broad climatic belts. The northwestern portion of the Basin around the Delta area is the drier of the two with about 6 inches of precipitation annually and a mean temperature of 49.4° F. The average altitude is about 4,700 feet. Departures from this occur along the western slopes of the Canyon and Pavant Ranges where precipitation reaches 35 inches. The Sevier River valleys comprise the balance of the area. Here the annual precipitation is higher, averaging about 10 inches in the valleys and up to 40 inches in the mountains. Mean annual temperatures are lower, ranging from 42.3° F in the Panguitch-Hatch area to 49.4° F in the central Sevier area.

The average daily range in temperature is about 30° F. Even during the hotter portions of the summer, the nights are cool making the Basin a desirable place to live in this respect.

Most of the cultivated agricultural lands are classed as arid although some areas of semiarid conditions permit dryland farming, notably around Levan and Scipio with smaller areas in upper Sanpete Valley.

Although anticyclonic conditions occur, accumulation of smoke and haze are not a serious problem. Infrequently, periods of fog conditions occur causing visibility problems.

Sunny skies prevail most of the year. There is an average of about 50 percent of the possible sunshine during December in the extreme northern portion of the Basin to 82 percent during September over the entire area. More sunshine prevails during the summer and fall months where the average is about 78 percent.

Wind speeds are usually light to moderate although strong winds occur occasionally. Tornadoes are relatively unknown.

Most of the climatic data presented in this report is representative of the valley areas because of the lack of data in the higher mountain areas. No attempt has been made to present data published elsewhere except that necessary for an understanding of the water and land resources of the Sevier River Basin.

Chapter II. P R E C I P I T A T I O N

In general, the precipitation records of the U. S. Weather Bureau climatological stations within the Basin are good. However, some of the station histories indicate the probability of erratic data. Those stations with the best records have the benefit of few changes in observers and location. One classic example is where the observer moved the station into town during the winter and to a ranch across the valley during the summer without the consent or knowledge of the Weather Bureau.

Several stations had missing data that was computed using standard correlation procedures. Values used for the Circleville station were computed from data available at Richfield and Panguitch through accepted correlation procedures.

Precipitation is the most variable of the climatic factors influencing the Sevier River Basin. An examination of the records shows annual extremes of 7.20 inches at Levan during 1931 to 26.22 inches during 1895 or a departure of 5.82 inches below and 13.20 inches above the annual mean of 13.02 inches. Monthly variations at this same station are even greater ranging from several months without precipitation to 7.18 inches during May 1895, a departure of 5.92 inches above the May mean of 1.26 inches (Table 1).

Two major storm paths influence the precipitation patterns in the Basin. During the winter and spring months, the bulk of the moisture is attributed to the movement of Pacific storms through the area. The southern fringe of many of these storms crosses the northern part of the Basin resulting in a 6-inch greater moisture content in the snow pack in this area during the winter months. Table 2 and Figure 1 show the 5-year trend in precipitation for the selected snow courses shown on Map 1.

The summer storms from the Gulf of Mexico yield more moisture to the southern portion of the Basin. These summer convective storms occur more frequently during July and August, cover smaller areas and are of greater intensity, depositing as much as 3 inches of moisture in some locations. However, they generally do not exceed 30 minutes in duration at this high intensity.

The desert portion of the Basin usually has wetter spring months which provide moisture for early vegetative growth. The mountainous areas and Sevier River valleys usually have more moisture during July and August. This is often detrimental to crop harvesting but improves the growing conditions for grazing lands.

TABLE 1.--Mean monthly precipitation on irrigated lands, Sevier River Basin, 1931-60

Watershed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
A-1	1.05	1.08	0.99	0.92	0.85	0.75	0.73	0.99	0.69	1.02	0.82	1.12	11.01
A-2	1.09	1.13	1.04	0.97	0.89	0.78	0.76	1.04	0.73	1.07	0.85	1.17	11.52
A-3	0.93	1.11	1.17	1.09	0.98	0.75	0.70	0.73	0.53	1.00	0.80	0.94	10.73
A-4	1.02	1.21	1.28	1.20	1.07	0.82	0.76	0.80	0.57	1.09	0.88	1.03	11.73
Mean	1.02	1.13	1.12	1.05	0.95	0.78	0.74	0.89	0.63	1.05	0.83	1.07	11.25
B-1	1.17	1.26	1.55	1.41	1.26	0.77	0.65	0.81	0.64	1.21	1.03	1.26	13.02
B-2	1.02	1.09	1.34	1.21	1.09	0.67	0.56	0.70	0.55	1.05	0.89	1.10	11.27
B-3[a]	0.90	0.97	1.19	1.08	0.97	0.59	0.50	0.62	0.49	0.93	0.79	0.97	10.00
B-4	1.20	1.27	1.34	1.06	0.99	0.75	0.70	0.85	0.57	1.08	0.93	1.10	11.84
B-5	1.03	1.10	1.29	1.25	1.15	0.70	0.50	0.87	0.54	1.09	0.98	1.02	11.52
B-6	1.12	1.22	1.38	1.13	0.99	0.59	0.54	0.64	0.42	0.83	0.92	0.96	10.74
B-7	0.46	0.43	0.64	0.78	0.76	0.41	0.43	0.51	0.33	0.62	0.46	0.55	6.38
Mean	0.99	1.05	1.25	1.13	1.03	0.64	0.55	0.71	0.51	0.97	0.86	0.99	10.68
C-1	0.90	1.06	1.12	1.05	0.94	0.72	0.67	0.70	0.50	0.96	0.77	0.91	10.30
C-2	0.97	1.14	1.21	1.13	1.01	0.78	0.72	0.76	0.54	1.03	0.83	0.98	11.10
C-3	1.00	1.19	1.26	1.17	1.05	0.80	0.74	0.79	0.56	1.07	0.86	1.01	11.50
C-4	0.98	1.16	1.23	1.15	1.03	0.79	0.74	0.77	0.55	1.05	0.85	1.00	11.30
C-5	0.93	1.10	1.17	1.09	0.97	0.75	0.70	0.73	0.52	1.00	0.80	0.94	10.70
C-6	0.90	1.06	1.12	1.05	0.94	0.72	0.67	0.70	0.50	0.96	0.77	0.91	10.30
Mean	0.95	1.12	1.18	1.11	0.99	0.76	0.71	0.74	0.53	1.01	0.81	0.96	10.87
D-1	0.64	0.66	0.75	0.70	0.80	0.56	0.82	0.80	0.53	0.65	0.57	0.59	8.07
D-2	0.91	0.94	1.05	0.99	1.13	0.79	1.15	1.13	0.75	0.92	0.81	0.83	11.40
D-3	0.91	0.94	1.05	0.99	1.13	0.79	1.15	1.13	0.75	0.92	0.81	0.83	11.40
D-4	0.60	0.62	0.69	0.66	0.75	0.52	0.76	0.75	0.50	0.61	0.54	0.55	7.55
D-5	0.64	0.65	0.74	0.70	0.79	0.55	0.81	0.79	0.53	0.65	0.57	0.58	8.00
D-6	0.60	0.60	0.80	0.70	0.80	0.60	0.90	1.10	0.80	0.90	0.60	0.60	9.00
D-7	0.60	0.60	0.80	0.70	0.80	0.60	0.90	1.10	0.80	0.90	0.60	0.60	9.00
D-8	0.60	0.50	0.70	0.60	0.70	0.60	0.80	0.90	0.80	0.80	0.60	0.60	8.20
Mean	0.69	0.69	0.82	0.76	0.86	0.63	0.91	0.96	0.68	0.79	0.64	0.65	9.08
E-1	0.56	0.54	0.70	0.48	0.91	0.77	1.24	1.70	0.75	0.94	0.50	0.50	9.59
E-2	0.53	0.52	0.67	0.46	0.87	0.73	1.19	1.63	0.71	0.90	0.48	0.48	9.17
E-3	0.68	0.96	0.57	0.63	0.70	0.48	1.39	1.54	1.29	0.92	0.69	0.55	10.40
E-4	0.75	1.06	0.63	0.70	0.77	0.53	1.53	1.70	1.43	1.02	0.76	0.62	11.50
E-5	1.01	0.81	0.94	0.62	0.48	0.51	0.83	1.46	0.99	1.18	0.55	1.04	10.42
Mean	0.70	0.78	0.70	0.58	0.75	0.60	1.24	1.61	1.03	0.99	0.60	0.64	10.22
F-1	0.56	0.52	0.69	0.57	0.65	0.54	0.79	0.85	0.72	0.75	0.53	0.53	7.70
F-2	0.58	0.57	0.71	0.63	0.61	0.52	1.40	1.51	0.88	0.93	0.48	0.58	9.40
F-3	0.58	0.57	0.71	0.63	0.61	0.52	1.40	1.51	0.88	0.93	0.48	0.58	9.40
F-4	0.62	0.61	0.75	0.67	0.65	0.55	1.49	1.60	0.94	0.99	0.51	0.62	10.00
F-5	0.74	0.73	0.90	0.81	0.78	0.66	1.79	1.92	1.13	1.19	0.61	0.74	12.00
Mean	0.62	0.60	0.75	0.66	0.66	0.56	1.37	1.48	0.91	0.96	0.52	0.61	9.70
Basin mean	0.83	0.89	0.97	0.88	0.87	0.67	0.92	1.07	0.71	0.96	0.71	0.82	10.30

[a]There are no irrigated lands in this watershed - Values are for the nonirrigated area.

Source: U. S. Weather Bureau monthly and annual Climatological Data.

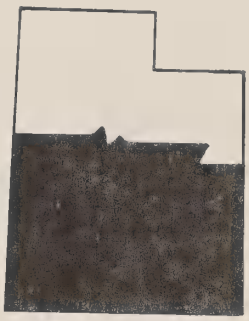
Map 1: SELECTED SNOW MEASUREMENT STATIONS
SOUTHERN UTAH
Sevier River Basin
Utah

INDEX

11K11	G.B.R.C. Headquarters
11K3	Mammoth R.S. Cottonwood Creek
11K4	Gooseberry Reservoir
11K5	Huntington – Horseshoe
11K9	Seeley Creek R.S.
11K10	G.B.R.C. Meadows
11K36	Rees's Flat
11L2	Gooseberry R.S.
12L11	Shingle Mill
11L3	Fish Lake
12L6	Kimberly Mine
12L9	Merchant's Valley
12L8	Otter Lake
12L7	Big Flat
11M1	Widtsoe-Escalante Summit
12M7	Panguitch Lake
12M8	Bryce Canyon
12M1	Cedar Breaks
12M3	Webster Flat
12M4	Duck Creek
12M6	Long Valley Junction

LEGEND

- Snow Course
- Snow Course and Storage Precipitation Gage
- Snow Course, Soil Moisture Station and Storage Precipitation Gage



LOCATION MAP

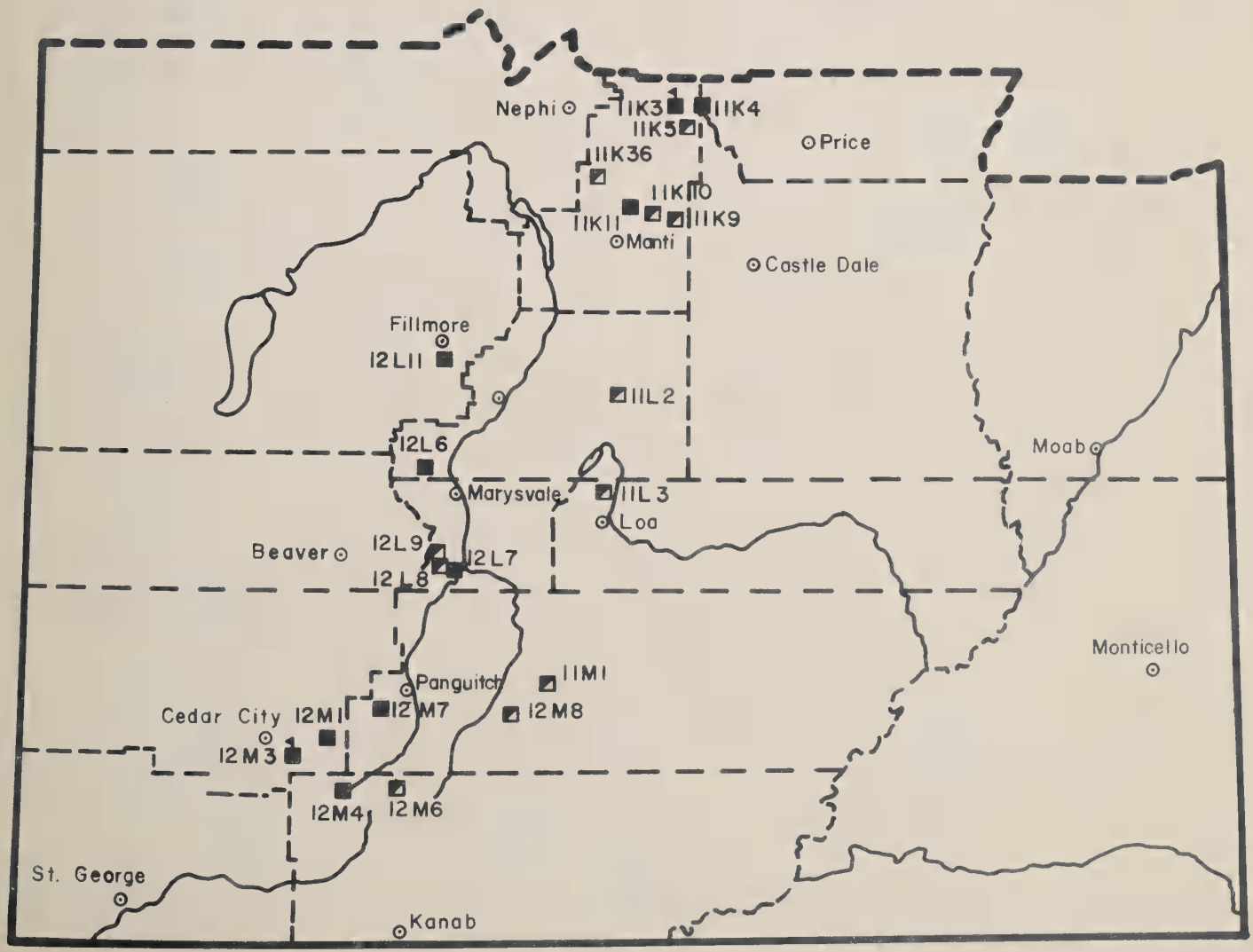


TABLE 2.--5-year average precipitation for 21 selected snow courses,[a] Sevier River Basin, 1939-67

Year	8 Northern courses SRB	13 Southern courses SRB	21 Courses total
	Inches	Inches	Inches
1939	19.9	14.6	16.6
1940	20.1	13.9	16.4
1941	19.0	14.2	16.2
1942	18.5	12.8	15.2
1943	17.7	12.1	14.4
1944	18.6	13.6	15.7
1945	18.5	15.1	16.4
1946	17.5	13.9	15.3
1947	16.7	13.4	14.6
1948	17.0	13.6	14.9
1949	17.6	14.0	15.4
1950	17.4	12.6	14.4
1951	17.2	12.0	14.0
1952	21.6	14.7	17.4
1953	21.1	13.3	16.3
1954	19.9	11.9	15.0
1955	19.5	12.1	14.9
1956	19.8	12.6	15.4
1957	17.0	9.9	12.6
1958	18.9	11.8	14.5
1959	18.4	10.8	13.6
1960	18.4	10.3	13.4
1961	18.0	10.3	13.2
1962	18.4	11.3	14.0
1963	16.3	8.8	11.7
1964	15.3	9.0	11.8
1965	14.8	9.5	12.6
1966	13.8	9.5	12.5
1967	14.1	7.4	10.4

[a]Values are 5-year trends of snow courses in and near the Sevier River Basin. Refer to Map 1 for location.

Source: "Summary of Snow Survey Measurements for Utah," U. S. Department of Agriculture, Soil Conservation Service and State Engineer of Utah.

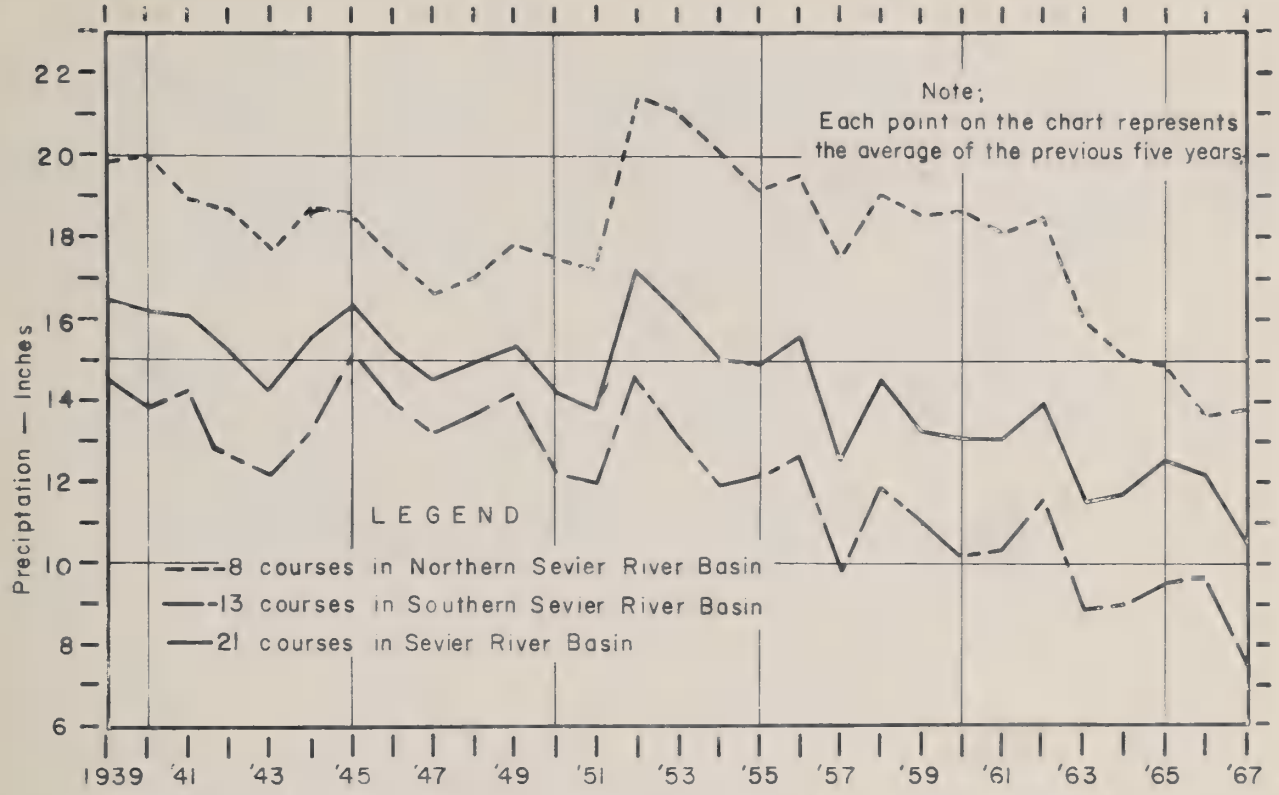


Figure 1: 5—Year average precipitation for 21 selected snow courses.

April 1 reading for years 1939 thru 1967

Sevier River Basin
Utah

A general drought has prevailed in the headwaters of the Sevier River, especially during the 1950's and early 1960's. However, precipitation has been less than the long-term mean since the late 1920's. Precipitation-streamflow comparisons have indicated that decreases in runoff are proportionately greater than decreases in precipitation and also, there is a definite lag effect which varies according to peculiarities of the groundwater system.

Map 3 (main report number) shows the mean annual precipitation and water surface evaporation for the Sevier River Basin. The precipitation was adapted from the U. S. Weather Bureau normal annual precipitation map.

Specific precipitation data for each area was determined as outlined in the following paragraphs. All values used in the report were adjusted to represent the 1931-60 base period considered in the study.

SUB-BASIN A

Normal monthly precipitation values for the Moroni and Manti stations were used to determine the monthly distribution of the annual values measured from the precipitation map. Moroni was used for Watersheds A-1 and A-2 and Manti for Watersheds A-3 and A-4.

Annual values for the wetland areas are as follows: Watershed A-1, 9.95 inches; Watershed A-2, 10.25 inches; Watershed A-3, 9.49 inches; and Watershed A-4, 11.16 inches. These were distributed monthly at the same proportion as for the irrigated lands in Table 1.

SUB-BASIN B

The following stations were used to distribute the annual precipitation to monthly values with the values in parentheses the annual precipitation on the wetlands: Levan, Watersheds B-1, B-2 above Chicken Creek Reservoir (11.50 inches), B-2 below the reservoir (10.00 inches), B-3 (10.00 inches); Scipio, Watershed B-4 (14.0 inches); Oak City, Watershed B-5 (10.50 inches); Fillmore, Watershed B-6 (10.74 inches); Deseret, Watershed B-7 (6.38 inches). The annual precipitation in the wetlands was distributed at the same rate as for the irrigated areas shown in Table 1.

LEGEND

16 — Annual precipitation

52.00 in — Water surface evaporation

Note: Water surface evaporation values apply to the water budget areas. All values are 1931-1960 averages

SOURCE: Evaporation from field party studies, precipitation from weather bureau maps.

LOCATION MAP

MAP 3

PRECIPITATION AND WATER SURFACE EVAPORATION MAP

NORTH HALF

SEVIER RIVER BASIN

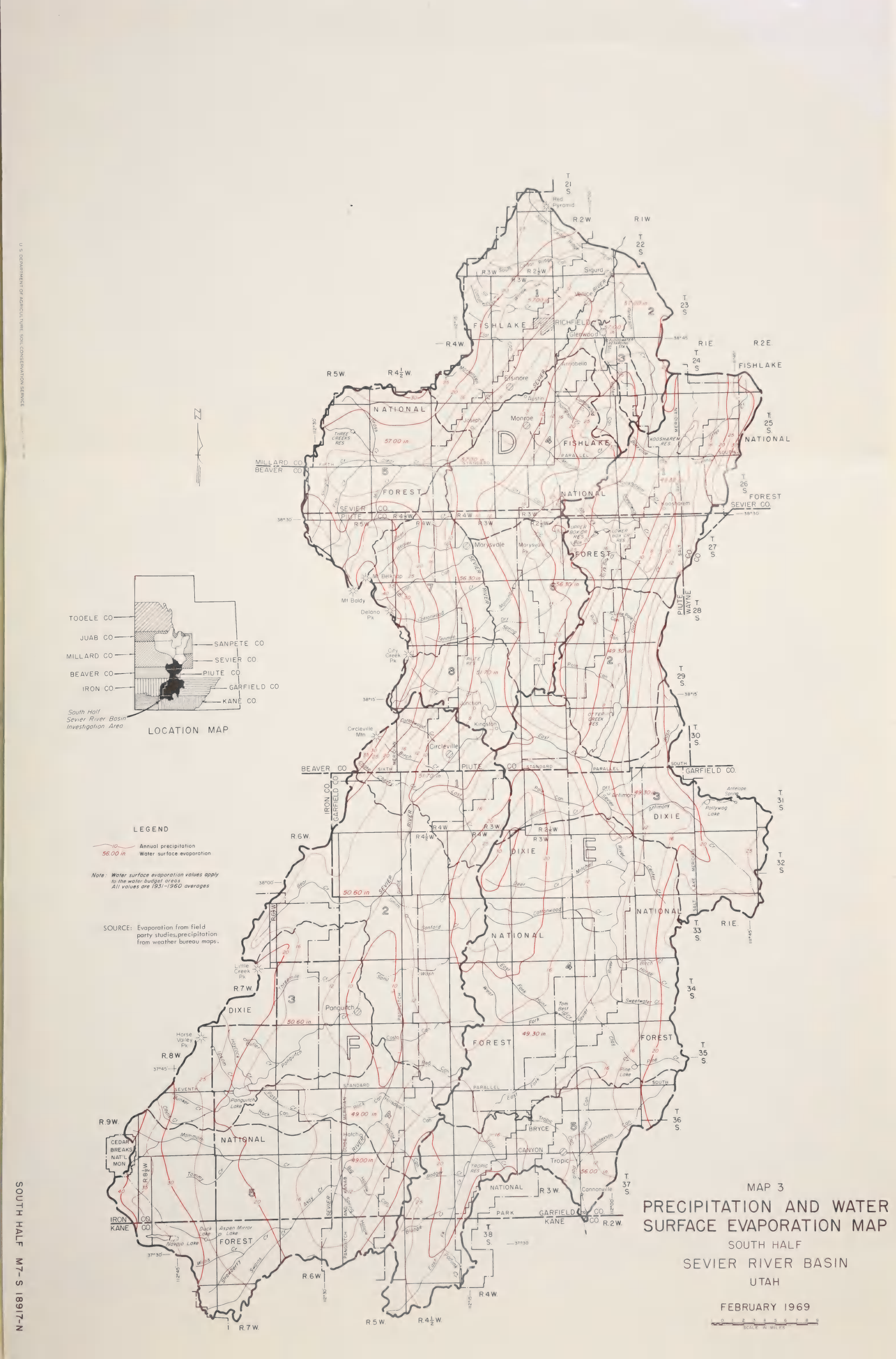
UTAH

FEBRUARY 1969

SCALE IN MILES 0 1 2 3 4 5 6 7 8 9

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

NORTH HALF M7-S-18917-N



U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

SOUTH HALF M7-S 18917-N

SUB-BASIN C

The distribution patterns of precipitation of the Richfield, Salina, Gunnison Sugar Factory and Manti Climatological Stations were studied to determine a representative station for Sub-basin C. This study indicated the Manti record was representative of most of the other stations. It was used for this reason and also because of its long continuous record which was lacking at most of the other stations. The values used for the nonirrigated - nonrotated areas were the same as those for the irrigated areas.

SUB-BASIN D

The normal monthly precipitation values for the base period at the Richfield Climatological Station were used to distribute the weighted precipitation in Watersheds D-1 through D-5. The Piute Dam station was used for Watersheds D-6 and D-7 and the Circleville station for Watershed D-8. The short-term record at Circleville was extended to the base period by correlation with Piute Dam.

In order to balance the water budgets in Watersheds D-1 through D-5, the weighted precipitation was reduced one inch in the water-budget area. All other water-budget element adjustments had been made prior to this in order to eliminate any arbitrary judgements.

The precipitation on the wetlands in Watersheds D-1 through D-5 was 8.44 inches annually and was distributed at the same rate as those for the irrigated areas in Table 1. The values in the balance of Sub-basin D were the same as those used on the irrigated lands.

SUB-BASIN E

The Koosharem Climatological Station precipitation record (1955-1963) was correlated with that at Loa to establish a base period distribution. This distribution was used for Watersheds E-1 and E-2.

Watershed E-1 was divided into four areas to determine the weighted precipitation and distribution on the water-budget area. These are tabulated below.

TABLE 3.--Weighted precipitation and distribution in Watershed E-1

Month	Koosharem Station distribution	Above Koosharem Reservoir	Koosharem Reservoir	Irrigated lands	Wetlands
	Percent	Inches	Inches	Inches	Inches
January	5.78	0.70	0.66	0.56	0.64
February	5.68	0.68	0.65	0.54	0.63
March	7.26	0.87	0.84	0.70	0.81
April	5.05	0.61	0.58	0.48	0.56
May	9.46	1.14	1.09	0.91	1.05
June	7.99	0.96	0.92	0.77	0.89
July	12.93	1.55	1.49	1.24	1.44
August	17.77	2.13	2.04	1.70	1.98
September	7.78	0.93	0.90	0.75	0.87
October	9.78	1.17	1.13	0.94	1.09
November	5.26	0.63	0.60	0.50	0.58
December	5.26	0.63	0.60	0.50	0.58
Annual	100.00	12.00	11.50	9.59	11.12

To determine the distribution pattern in Watersheds E-3 and E-4, the Widtsoe Climatological Station record (1915-1935) was correlated with the Panguitch record to obtain the base period values. The weighted precipitation for these water-budget areas was then distributed monthly at this rate. The irrigated area precipitation is shown in Table 1 and the wetland precipitation for Watersheds E-3 (9.80 inches annually) and E-4 (11.00 inches annually) were distributed at the same rate.

The precipitation record at the Tropic Climatological Station was used for all areas of consumptive use in Watershed E-5. This record was used for the weighted annual value as well as distribution. The storm pattern and intensity and the cropland pattern along with soils of less infiltration rates, produces more direct runoff that could not be utilized in the water-budget area. For this reason, the effective precipitation is 80 percent of the normal amounts.

SUB-BASIN F

The monthly distribution of the weighted precipitation in Watershed F-1 was based on a correlation of the Piute Dam and Circleville Climatological Stations. The same rate and amounts per month were used in all water-budget areas.

A correlation between the Hatch and Panguitch Climatological Stations indicates the latter record can be used to distribute the annual weighted distribution for the balance of Sub-basin F. The same weighted amounts were used for all of the water-budget areas.

Chapter III. T E M P E R A T U R E

Temperature variations are less erratic than any other climatic factor. The changes in mean temperature vary with latitude and elevation. Over the Basin, there is a decrease in mean temperature of about 1° F with each 1° increase in latitude and a decrease of about 3° F for each 1,000-foot increase in altitude at the valley stations. The increase of temperature with latitude does not give a true picture because of the overriding influence of elevation changes.

Mean annual temperatures vary about 10° F, from 42.3° F at Hatch to 52.4° F at Oak City. Temperatures over 100° F occur occasionally in summer and below zero weather occurs at most stations nearly every year. Generally, these extremes are short in duration as the area is protected from the intensely cold continental arctic air masses by the mountain barriers. Low humidity makes these temperature extremes more bearable than in more humid climates. The hottest recorded temperature was 111° F at Mt. Pleasant while the coldest was -40° F at Scipio.

The Sevier River Basin experiences relatively strong insolation during the day and rapid nocturnal cooling at night. This results in wide daily ranges in temperature, frequently as much as 40° F.

Temperature records for some stations in the Basin are incomplete and frequent station location changes have been made. In these cases, missing data has been computed using standard accepted procedures. For some areas, mean temperatures have been computed using nearby station records and adiabatic lapse rates. Mean, mean maximum and mean minimum temperatures are shown in Tables 4 and 5.

Table 6 lists the Climatological Station records used to determine temperature data for the individual watersheds. The method used to determine these values is also indicated.

TABLE 4.--Mean monthly temperatures, Sevier River Basin, 1931-60

Watershed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F
A-1	25.00	29.00	37.50	47.00	55.00	63.00	70.00	69.00	61.00	50.30	36.00	28.00	47.60
A-2	25.00	29.00	37.50	47.00	55.00	63.00	70.00	69.00	61.00	50.30	36.00	28.00	47.60
A-3	25.00	29.00	37.50	47.00	55.00	63.00	70.00	69.00	61.00	50.30	36.00	28.00	47.60
A-4	25.00	29.00	37.50	47.00	55.00	63.00	70.00	69.00	61.00	50.30	36.00	28.00	47.60
Mean	25.00	29.00	37.50	47.00	55.00	63.00	70.00	69.00	61.00	50.30	36.00	28.00	47.60
B-1	25.90	30.70	39.10	48.40	56.10	64.60	73.00	71.60	63.60	51.90	38.00	30.00	49.40
B-2	25.90	30.70	39.10	48.40	56.10	64.60	73.00	71.60	63.60	51.90	38.00	30.00	49.40
B-3	25.90	30.70	39.10	48.40	56.10	64.60	73.00	71.60	63.60	51.90	38.00	30.00	49.40
B-4	24.80	29.80	38.10	47.10	55.10	63.60	71.30	69.50	60.70	49.40	35.70	28.40	47.80
B-5	28.70	33.60	41.30	50.50	59.20	68.80	77.90	76.10	67.10	55.00	39.20	31.90	52.40
B-6	29.10	33.60	41.40	50.80	59.20	68.50	77.10	75.40	66.90	54.60	40.00	32.40	52.40
B-7	26.00	31.90	39.80	48.80	57.10	65.50	74.10	69.30	63.10	51.20	36.70	29.30	49.40
Mean	26.61	31.57	39.70	48.91	56.99	65.74	74.20	72.16	64.09	52.27	37.94	30.29	50.03
C-1	26.00	30.50	38.20	46.50	55.40	65.70	72.60	71.00	61.50	50.80	36.30	28.50	48.60
C-2	26.00	30.50	38.20	46.50	55.40	65.70	72.60	71.00	61.50	50.80	36.30	28.50	48.60
C-3	25.70	30.00	38.00	46.80	55.10	64.30	71.30	69.80	61.30	50.50	36.50	28.80	48.20
C-4	26.00	30.50	38.20	46.50	55.40	65.70	72.60	71.00	61.50	50.80	36.30	28.50	48.60
C-5	26.00	30.50	38.20	46.50	55.40	65.70	72.60	71.00	61.50	50.80	36.30	28.50	48.60
C-6	26.00	30.50	38.20	46.50	55.40	65.70	72.60	71.00	61.50	50.80	36.30	28.50	48.60
Mean	25.95	30.42	38.17	46.55	55.35	65.45	72.38	70.80	61.47	50.75	36.33	28.55	48.53
D-1	28.40	32.70	40.20	48.20	56.50	64.60	71.60	69.90	61.70	50.80	37.70	30.80	49.40
D-2	28.40	32.70	40.20	48.20	56.50	64.60	71.60	69.90	61.70	50.80	37.70	30.80	49.40
D-3	28.40	32.70	40.20	48.20	56.50	64.60	71.60	69.90	61.70	50.80	37.70	30.80	49.40
D-4	28.40	32.70	40.20	48.20	56.50	64.60	71.60	69.90	61.70	50.80	37.70	30.80	49.40
D-5	28.40	32.70	40.20	48.20	56.50	64.60	71.60	69.90	61.70	50.80	37.70	30.80	49.40
D-6	27.30	31.30	37.80	46.50	54.70	65.00	70.40	69.00	61.00	51.20	37.40	29.70	48.40
D-7	27.30	31.30	37.80	46.50	54.70	65.00	70.40	69.00	61.00	51.20	37.40	29.70	48.40
D-8	26.50	29.70	37.10	45.50	53.30	61.20	67.80	66.30	58.80	48.20	35.60	28.30	46.50
Mean	27.89	31.98	39.21	47.44	55.65	64.28	70.83	69.23	61.16	50.58	37.36	30.21	48.79
E-1	24.30	26.40	32.50	41.50	49.80	58.50	65.50	63.60	57.10	46.50	33.90	27.30	43.90
E-2	24.30	26.40	32.50	41.50	49.80	58.50	65.50	63.60	57.10	46.50	33.90	27.30	43.90
E-3	24.30	26.40	32.50	41.50	49.80	58.50	65.50	63.60	57.10	46.50	33.90	27.30	43.90
E-4	24.30	26.40	32.50	41.50	49.80	58.50	65.50	63.60	57.10	46.50	33.90	27.30	43.90
E-5	28.10	31.50	38.00	46.60	54.40	62.40	68.70	66.60	60.60	50.00	38.30	31.90	48.10
Mean	25.06	27.42	33.60	42.52	50.72	59.28	66.14	64.20	57.80	47.20	34.78	28.22	44.74
F-1	25.60	29.70	37.10	45.50	53.30	61.20	67.80	66.30	58.80	48.20	35.60	28.30	46.45
F-2	22.70	26.70	34.00	42.80	50.10	57.80	64.10	62.70	55.80	45.50	33.60	25.80	43.50
F-3	22.70	26.70	34.00	42.80	50.10	57.80	64.10	62.70	55.80	45.50	33.60	25.80	43.50
F-4	21.60	25.50	32.80	41.70	48.80	56.50	62.60	61.30	54.60	44.50	32.80	24.80	42.30
F-5	21.60	25.50	32.80	41.70	48.80	56.50	62.60	61.30	54.60	44.50	32.80	24.80	42.30
Mean	22.84	26.82	34.14	43.00	50.22	57.96	64.24	62.86	55.92	45.64	33.68	25.90	43.61
Basin mean	25.85	29.90	37.41	46.18	54.31	63.01	70.06	68.43	60.55	49.98	36.25	28.79	47.54

Source: U. S. Weather Bureau monthly and annual Climatological Data.

TABLE 5.--Mean monthly maximum and minimum temperatures for selected stations, Sevier River Basin

Station	Monthly means																								Annual mean	
	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec			
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F
Delta AP	37.5	12.6	44.0	18.8	52.4	24.9	64.6	34.6	74.4	42.5	83.1	48.8	94.1	58.1	92.2	56.9	82.6	46.4	68.1	35.8	50.5	22.4	41.5	17.8	65.4	35.0
Levan	36.8	13.1	42.6	18.9	52.3	25.7	63.8	33.8	71.5	40.9	80.0	48.0	89.1	56.1	87.8	55.2	80.3	46.7	67.3	36.2	51.3	24.2	41.3	18.4	63.7	34.8
Manti	35.9	13.1	40.9	17.8	50.4	24.7	61.8	32.6	70.5	39.1	70.5	46.0	86.3	53.2	52.3	32.1	77.3	44.2	65.7	34.6	49.8	23.4	39.9	17.7	58.4	31.5
Marysvale	42.8	13.1	47.5	21.1	52.3	21.9	62.6	29.6	72.7	33.3	91.9	58.9	89.3	49.0	48.8	37.2	79.7	40.4	68.3	30.9	53.2	20.1	45.3	14.9	62.9	30.9
Moroni	36.3	11.2	41.3	15.2	51.6	23.0	65.0	30.6	74.7	37.1	83.5	43.3	91.5	50.9	89.6	49.7	82.3	40.6	69.8	32.1	51.1	20.8	39.8	15.1	64.7	30.8
Panguitch	37.6	5.7	41.8	10.8	49.8	17.8	61.3	24.9	69.1	30.7	77.9	36.7	83.5	43.9	81.5	43.1	76.6	34.4	65.5	24.9	51.7	14.9	41.4	9.2	61.5	24.8
Piute Dam	40.1	11.7	45.2	17.4	52.7	23.2	63.3	31.3	71.3	38.8	80.4	46.2	87.2	54.2	86.4	53.1	80.0	43.7	68.9	33.5	55.7	21.3	44.5	15.9	64.6	32.5
Richfield	41.2	14.1	47.0	18.8	55.9	24.9	65.7	31.1	75.2	38.2	84.5	45.6	91.8	52.3	89.7	50.9	82.3	41.9	69.8	32.1	54.1	21.5	44.7	17.5	66.8	32.4
Salina	41.3	14.2	45.6	19.1	53.3	24.1	64.6	31.6	74.1	39.4	85.1	46.5	92.3	53.8	89.8	52.4	82.7	42.8	70.7	32.0	53.1	21.4	43.1	15.0	66.3	32.7
Scipio	37.4	10.2	43.5	16.7	52.5	23.6	64.0	31.1	73.7	37.5	82.3	44.7	90.0	52.5	87.8	51.2	80.6	40.5	68.2	31.2	51.2	20.2	41.8	15.5	64.4	31.2
Tropic	39.7	14.9	43.4	18.3	50.8	24.3	61.6	32.0	70.9	38.5	79.5	44.4	85.4	51.3	83.4	50.4	77.4	43.7	64.9	34.2	51.6	23.6	43.6	18.9	62.7	32.9
Mean	38.8	12.2	43.9	17.5	52.2	23.5	63.5	31.2	72.6	37.8	81.7	46.3	89.1	52.3	80.8	48.4	80.2	42.3	67.9	32.5	52.1	21.2	42.4	16.0	63.8	31.8

Source: U. S. Weather Bureau monthly and annual Climatological Data.

TABLE 6.--U. S. Weather Bureau Climatological Station records used to determine temperature data

Watershed	Climatological Stations	Method
A-1, 2, 3 & 4	Manti, Moroni	Graphic correlation of means
B-1, 2 & 3	Levan	Mean
B-4	Scipio	Mean
B-5	Oak City	Mean
B-6	Fillmore	Mean
B-7	Deseret	Mean
C-1, 2, 4, 5 & 6	Gunnison Sugar Factory, Richfield	Graphic correlation
C-3	Gunnison Sugar Factory, Richfield, Manti	Mean of Manti and balance of sub-basin
D-1, 2, 3, 4 & 5	Richfield	Mean
D-6 & 7	Marysvale, Piute Dam	Graphic correlation
D-8	Richfield, Panguitch	Adiabatic lapse rate
E-1, 2, 3 & 4	Loa, Koosharem, Widtsoe, Panguitch	Graphic correlation
E-5	Tropic	Mean
F-1	Richfield, Panguitch	Adiabatic lapse rate
F-2 & 3	Panguitch	Mean
F-4 & 5	Richfield, Panguitch	Adiabatic lapse rate

Chapter IV. G R O W I N G S E A S O N S

Frost-free periods vary considerably throughout the Basin, ranging from 98 days in the Panguitch area to 178 days at Oak City. Wide variations also occur within portions of major valleys depending on location with respect to side canyons, bench areas and flat bottom lands. On occasion, frosts in some areas are less than two months apart.

The crop growing seasons were computed based on the 1931-60 average climatic conditions and Technical Release Number 21, "Irrigation Water Requirements," published by the Soil Conservation Service. Use was also made of Technical Publication Number 8, "Consumptive Use and Water Requirements for Utah," 1962, published by the Utah State Engineer's Office along with several other studies available.

Some growing season data does not agree entirely with Technical Release Number 21 as it was published after a portion of the study was completed. In some cases, data was adjusted to better fit local conditions.

Table 7 shows the growing seasons calculated for the Sevier River Basin. These values were used to determine the potential consumptive use for the indicated crops. Annual consumptive use for native vegetation along with alfalfa and pasture was used for water budget purposes.

TABLE 7.--Crop growing seasons, Sevier River Basin

Watershed	Alfalfa		Spring grain		Field corn		Potatoes		Sugar beets		Pasture		Deciduous orchards	
	50° mean temp.	First 28° frost	45° mean temp.	120 days growing season	55° mean temp.	120 days growing season	60° mean temp.	First 32° frost	28° mean temp.	180 days or 28°	45° mean temp.	45° mean temp.	50° mean temp.	45° mean temp.
Sub-basin A														
A-1, A-2, A-3 & A-4	4/26	10/12	4/7	8/4	5/14	9/10								
Sub-basin B														
B-1, B-2 & B-3	4/22	10/12	4/3	8/1										
B-4	4/28	9/23	4/9	8/7										
B-5	4/13	10/21	3/27	7/25	4/30	8/28	5/18	9/24						
B-6	4/16	10/19	3/30	7/28	5/3	8/31	5/21	9/28	4/24	10/19				
B-7	4/19	10/2	4/2	7/3	5/6	9/3			5/2	10/2				
Sub-basin C														
C-1	4/28	10/3	4/9	8/7	5/14	9/10			5/8	10/3				
C-2	4/28	10/3	4/9	8/7	5/14	9/10			5/8	10/3				
C-3a Gunnison area	4/28	10/3	4/9	8/7	5/14	9/10			5/8	10/3				
C-3b Sterling-Mayfield area	4/27	10/12	4/9	8/7										
C-4	4/28	10/3	4/9	8/7	5/14	9/10			5/8	10/3				
C-5	4/28	10/3	4/9	8/7	5/14	9/10			5/8	10/3				
C-6	4/28	10/3	4/9	8/7	5/14	9/10			5/8	10/3				
Sub-basin D														
D-1	4/23	10/3	4/5	8/3	5/10	9/8	5/10	8/22	5/8	10/3				
D-2	4/23	10/3	4/5	8/3	5/10	9/8	5/10	8/22	5/8	10/3				
D-3	4/23	10/3	4/5	8/3	5/10	9/8	5/10	8/22	5/8	10/3				
D-4	4/23	10/3	4/5	8/3	5/10	9/8	5/10	8/22	5/8	10/3				
D-5	4/23	10/3	4/5	8/3	5/10	9/8	5/10	8/22	5/8	10/3				
D-6	4/25	9/19	4/10	8/7	5/16	9/11	5/16	8/27						
D-7	4/25	9/19	4/10	8/7	5/16	9/11	5/16	8/27						
D-8	5/2	9/24	4/13	8/10	5/21	9/14	5/21	9/2						
Sub-basin E														
E-1	5/15	9/15	4/28	8/26	6/2	9/30	6/1	9/9			4/28	10/18		
E-2	5/15	9/15	4/28	8/26	6/2	9/30	6/1	9/9			4/28	10/18		
E-3	5/15	9/15	4/28	8/26	6/2	9/30	6/1	9/9			4/28	10/18		
E-4	5/15	9/15	4/28	8/26	6/2	9/30	6/1	9/9			4/28	10/18		
E-5 Tropic area	4/28	10/8	4/10	8/8	5/17	9/14	6/4	10/6			4/10	10/27	4/28	10/27
Sub-basin F														
F-1	5/2	9/24	4/13	8/10	5/21	9/17	5/21	9/2						
F-2	5/15	9/14	4/24	8/21							4/24	10/16		
F-3	5/15	9/14	4/24	8/21							4/24	10/16		
F-4	5/19	9/10	4/28	8/25							4/28	10/14		
F-5	5/19	9/10	4/28	8/25							4/28	10/14		

Source: U. S. Weather Bureau monthly and annual Climatological Data.

Ashcroft, Gaylen L., and Derksen, W. J., "Freezing temperature probabilities in Utah," Agricultural Experiment Station, Utah State University, Bul. 439, 1963.

Chapter V. E V A P O R A T I O N

Although evaporation makes up a relatively minor portion of the total water use in the Sevier River Basin in total quantity, it is still a substantial amount. About 78,000 acre-feet is evaporated annually from major reservoir water surfaces alone. It is felt a more detailed evaporation map was needed to assist in the water-budget preparation and it is hoped this study was a step in that direction.

Considerable research is being conducted on the various aspects of evaporation. Work is being done on the interrelationship of the various climatic factors and their effect on total evaporation.

Most of the available data is for evaporation from larger lakes and reservoirs and maps showing these quantities are based on climatological data not readily available except at experimental locations and Class A Weather Bureau stations.

The National Engineering Handbook[a] contains maps for annual and monthly evaporation for "Shallow Lakes and Reservoirs." These maps were prepared from nomographs based on data from Class A Weather Bureau stations. The map scale is small and necessarily, the isopleths are quite general, especially in the more mountainous western states. For this reason, they cannot accurately reflect the changes in topography and climatic conditions found in the Sevier River Basin.

PROCEDURES

This study is an attempt to prepare monthly evaporation maps of the Sevier River Basin. No attempt was made to correlate these maps with any other existing maps although a comparison of the evaporation in several locations was made with the National Engineering Handbook[b] maps to show relative quantities.

Data was taken from U. S. Weather Bureau Climatological Stations for calculating the empirical values. Stations with pan evaporation records were used to aid in plotting the isopleths.

---

[a]Soil Conservation Service, USDA, National Engineering Handbook, Section 4, Chapter 9, 1961.

[b]Ibid.

The empirical relations were processed using a formula developed by Bal. B. Patil and modified by Kenneth Jose Mathison in an M. S. Thesis at USU (1963).[a]

The formula used is:

$$E = C_C\ C_T\ C_W\ C_{\Delta T}\ C_S\ C_E$$

E = Evaporation from a standard Weather Bureau Class A pan

where

$$C_C = C_R\ C_{\cos\ (L-D)}\ C_M$$

$$C_T = -0.26 + 0.02425T - 0.000075T^2$$

$$C_W = 0.8 + 0.0035W - 0.0000027W^2$$

$$C_{\Delta T} = 0.45 + (9.6 \times 10^{-4}\Delta T^2) - (2.76 \times 10^{-7}\Delta T^4)$$

$$C_S = 0.622 + 0.005875S - 0.000011S^2$$

$$C_E = 0.967 + 0.35E - 0.00156E^2$$

and where

$$C_R = 0.20R + 0.015R^2$$

$$C_{\cos} = 1.16 + 0.42 \cos\ (L-D) - 0.7\ \{\cos\ (L-D)\}^2$$

$$C_M = 1.0 + 0.00155\ (L-D) \cos\ \{\tfrac{\pi}{6}\ (N+1)\}$$

and where

C = Coefficient of the following parameters

R = Radiation

L = Latitude

D = Declination

---

[a]Patil, Bal. B., "A new formula for the evaluation of evaporation," 1962.

Mathison, Kenneth Jose, "The use of climatological and related factors for estimating evaporation," 1963.

M = Monthly coefficient

T = Temperature

W = Wind movement

ΔT = Mean maximum - mean minimum temperature

S = Sunshine

E = Elevation

N = Number of the month (1-12)

Using this formula, the pan evaporation can be calculated directly knowing the latitude, elevation, temperature, sunshine, and wind movement. Measurements of these elements except for wind movement and sunshine are available at many U. S. Weather Bureau Cooperative Climatological Stations. Wind movement data are available at the several evaporation stations where evaporation data are recorded.

The wind movement maps were prepared from interpolation of data at those stations where wind movement is measured and of necessity, with considerable freedom in judgement. The probable range in wind movement in the Sevier River Basin is from 50 to 100 miles per day.

Sunshine is measured in Utah only at the Salt Lake Weather Bureau Airport Station and of necessity, is assumed as being representative over the Sevier River Basin also. Sunshine for July ranged from 74 percent in 1961 to 91 percent in 1958 over the period 1950-63. This small latitude and the fact that in 8 of the 14 years, the sunshine was from 84 to 86 percent, partially justifies its use as a representative station over a wide area.

After the values for pan evaporation were calculated, plots were made of these values against the measured values where data was available. From the equation of the best fit line, a weighted value was obtained for all stations. This was then adjusted by the monthly pan coefficient to obtain the point water surface evaporation. These were the values used, along with judgement, to draw the isopleth lines of evaporation.

Preliminary calculations indicate the maximum probable error for misjudgement in wind and sunshine may approach 25 percent but it is very unlikely the error would exceed 10 percent of the calculated value.

The accuracy of the calculated value can be compared with the actual value at the Piute Dam and Gunnison Sugar Factory stations within the Basin. The latter station, however, has only one year of record.

For July, the calculated values for several stations are as follows with measured values in parentheses: Piute Dam, 12.98", (10.51"); Gunnison Sugar Factory, 12.68", (11.75"); Milford W. B. AP, 16.41", (16.00"); Utah Lake at Lehi, 13.76", (11.05"); Fish Springs, 13.82", (19.68", 1 year record).

From these figures, it appears that the calculated values are generally higher than the measured values. This was given weight when drawing the isopleths of evaporation.

Superficial study of the factors used in computing evaporation indicates that the temperature difference coefficient may have an undue effect where the difference is at the high or low end of the normal range.

PROPOSALS

The wind movement and water surface evaporation maps prepared in connection with this study have been used to assist with the study of water resources in the Sevier River Basin. They should also have value in other phases of work where a knowledge of this subject is mandatory. However, they should be used with judgement and consideration of any local influences not evaluated. It is not intended that this data should supersede any now available but that it could be used to modify and adapt available data to better express local conditions.

CONCLUSIONS

Because of the extreme variations in some of the climatic factors and the lack of evaporation stations in the Sevier River Basin, any calculated values are at best a good approximation. However, an evaporation pattern can be discerned when all factors are considered along with a knowledge of the climatic factors that affect evaporation.

It is believed that the isopleths shown on the evaporation maps are more indicative of the actual values of evaporation than the more generalized maps.

Table 8 shows the water surface evaporation values used in the water-budget studies. The monthly water surface evaporation maps show sunshine, wind movement, and water surface evaporation isopleths for the state of Utah determined as a result of this study.

TABLE 8.--Water surface evaporation, Sevier River Basin, 1931-60

Watershed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
Sub-basin A													
A-1, A-2, A-3 & A-4	.63	.88	1.50	2.90	5.50	7.35	10.10	10.00	6.80	3.75	1.70	.89	52.00
Sub-basin B													
B-1	.60	1.00	2.45	3.90	6.70	8.80	8.80	7.75	6.30	3.75	2.25	.70	53.00
B-2	.60	1.00	2.50	4.00	6.90	8.90	8.90	7.80	6.40	3.80	2.30	.70	53.80
B-3	.60	1.05	2.55	4.10	7.00	9.00	9.00	8.00	6.50	3.70	2.20	.65	54.35
B-4	.70	1.10	2.60	4.20	7.10	9.20	8.50	8.10	6.10	3.50	2.50	.80	54.40
B-5	.60	1.08	2.60	5.00	7.25	9.50	10.00	8.75	6.50	4.00	2.65	.75	58.68
B-6	.70	1.08	2.60	4.50	6.95	9.40	9.50	8.50	6.50	4.10	2.75	.77	57.35
B-7	.70	1.12	2.75	5.25	7.40	9.80	11.25	9.20	7.25	4.25	2.85	.77	62.59
Sub-basin C													
C-1, C-2, C-3, C-4, C-5 & C-6	.70	1.00	2.50	4.50	7.00	10.00	10.50	8.00	7.00	4.20	2.00	.80	58.20
Sub-basin D													
D-1, D-2, D-3, D-4, D-5	.80	1.20	2.50	4.00	7.00	9.00	10.00	8.00	7.00	4.30	2.30	.90	57.00
D-6 & D-7	.80	1.20	2.50	4.00	7.00	8.00	10.00	8.00	6.50	4.30	3.00	1.00	56.30
D-8	.80	1.10	2.50	4.00	6.00	7.40	8.80	7.00	6.00	4.10	3.00	1.00	51.70
Sub-basin E													
E-1, E-2, E-3 & E-4	.70	1.20	2.50	4.00	6.00	8.20	7.80	6.30	5.80	3.70	2.30	.80	49.30
E-5	.80	1.30	2.60	4.00	5.90	8.70	9.60	8.30	7.30	4.10	2.40	1.00	56.00
Sub-basin F													
F-1	.80	1.10	2.50	4.00	6.00	7.40	8.80	7.00	6.00	4.10	3.00	1.00	51.70
F-2 & F-3	.70	1.10	2.20	4.10	6.00	7.50	8.50	7.20	6.20	4.10	2.20	.80	50.60
F-4 & F-5	.70	1.00	2.20	4.10	6.00	7.20	8.00	7.00	6.00	4.00	2.20	.80	49.20

Map 2:

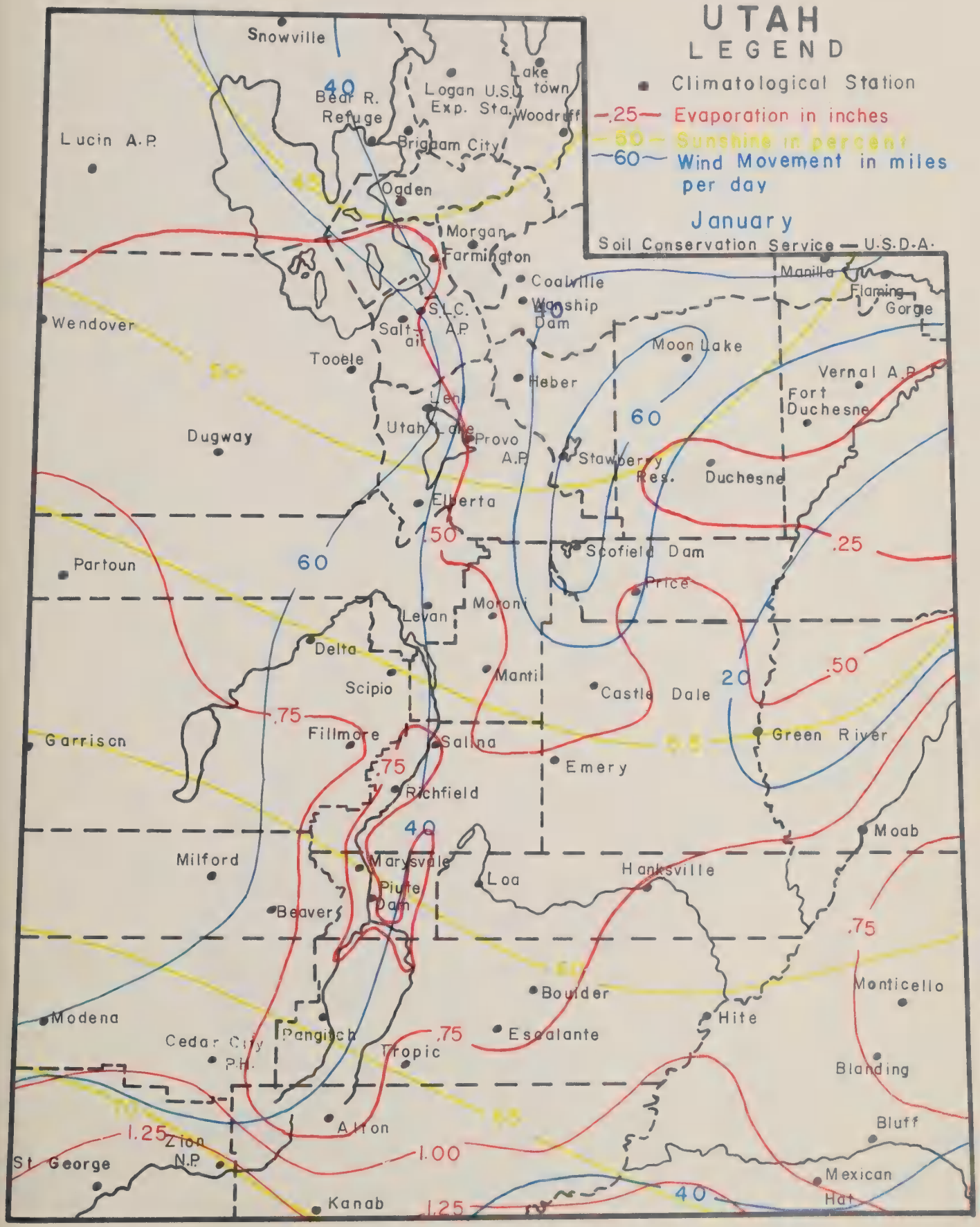
UTAH

LEGEND

- Climatological Station
- .25 — Evaporation in inches
- 50 — Sunshine in percent
- 60 — Wind Movement in miles per day

January

Soil Conservation Service — U.S.D.A.



Map 2:

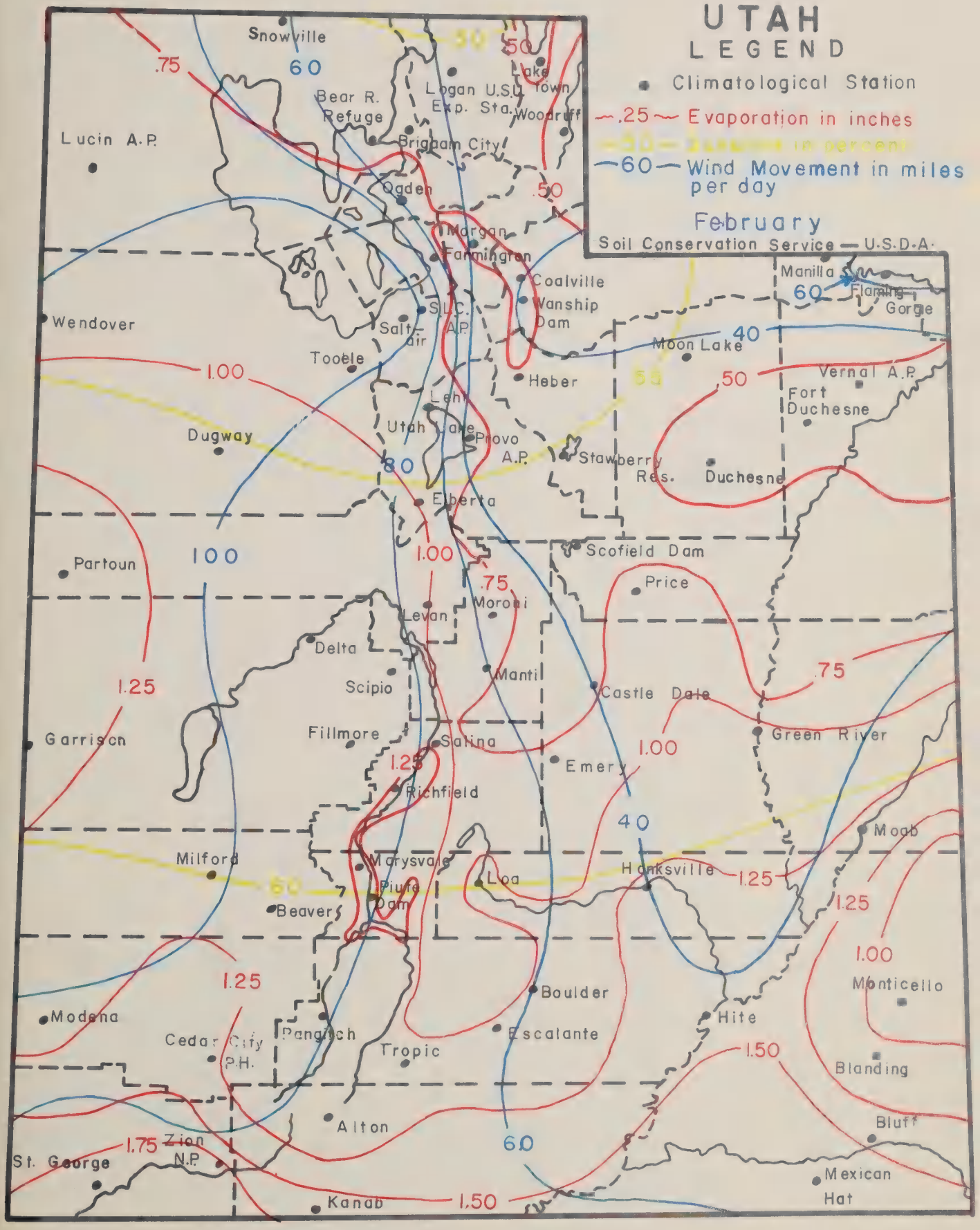
UTAH

LEGEND

- Climatological Station
- .25 Evaporation in inches
- 50 Humidity in percent
- 60 Wind Movement in miles per day

February

Soil Conservation Service — U.S.D.A.



Map 2:

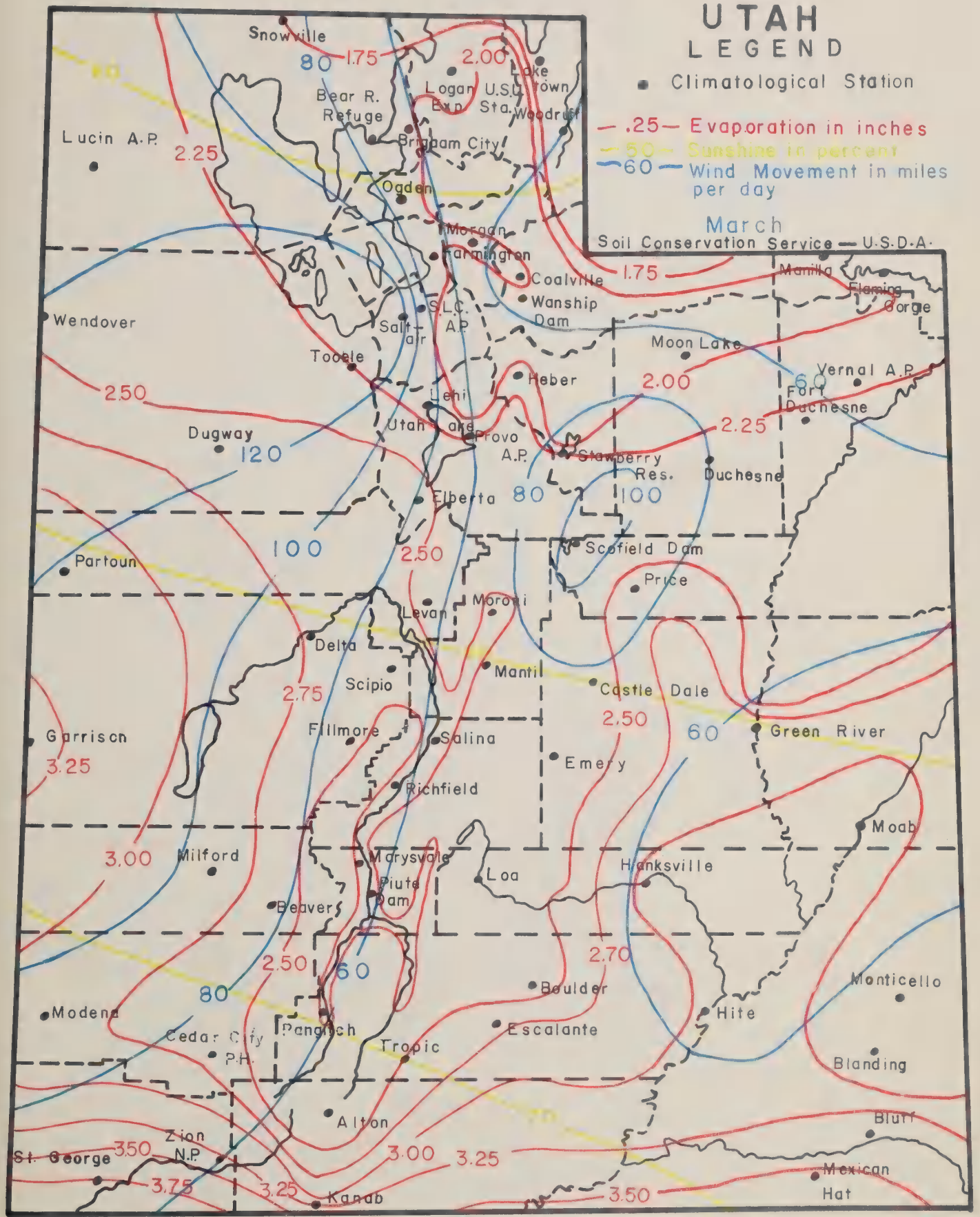
UTAH

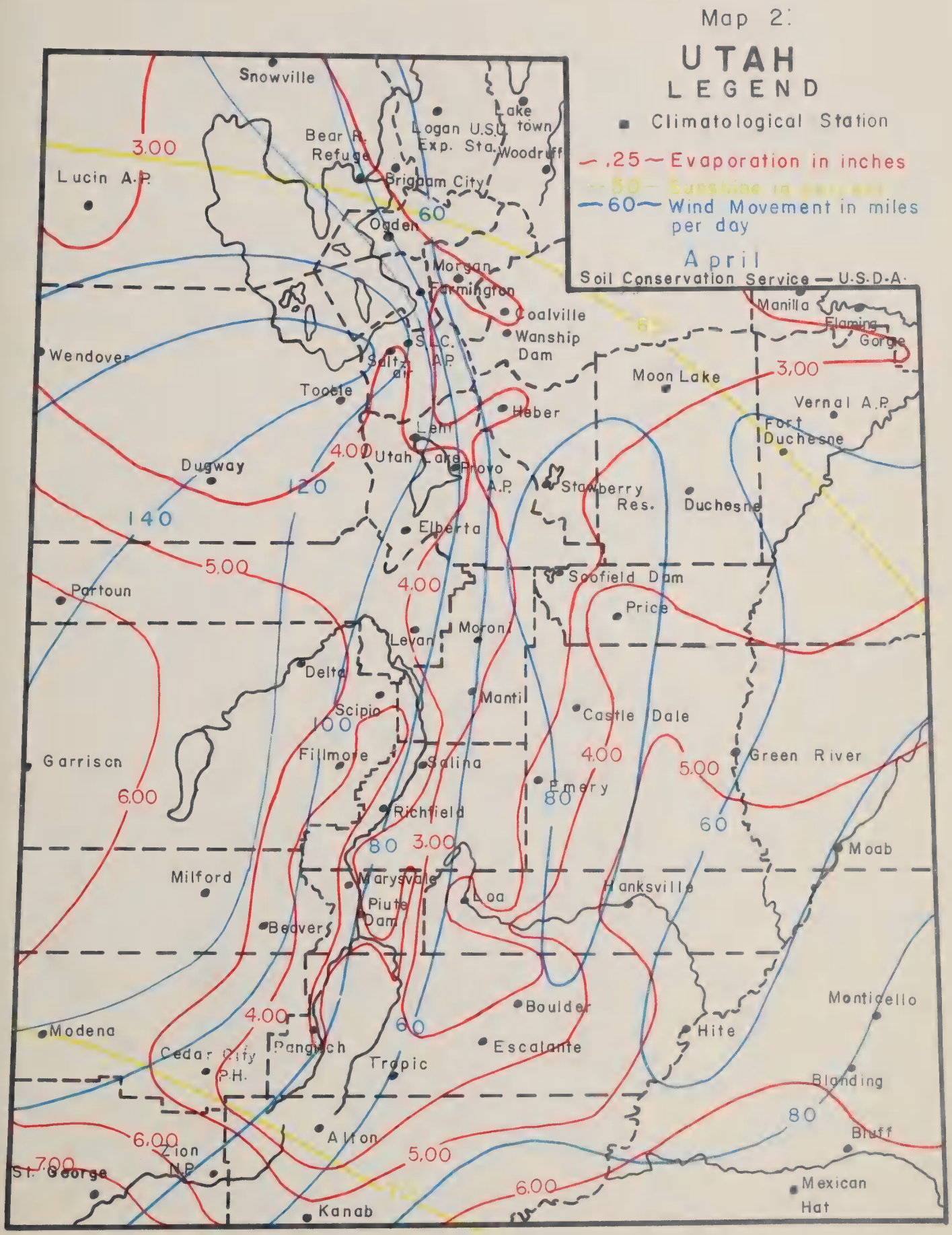
LEGEND

- Climatological Station
- .25 Evaporation in inches
- 50 Sunshine in percent
- 60 Wind Movement in miles per day

March

Soil Conservation Service — U.S.D.A.




Map 2:
UTAH
LEGEND
Climatological Station
.25 Evaporation in inches
60 Wind Movement in miles per day
April
Soil Conservation Service — U.S.D.A.
Snowville
Lucin A.P.
Bear R. Refuge
Logan U.S.U. Exp. Sta.
Lake town
Woodruff
Brigham City
Ogden
Morgan
Farmington
Coalville
Wanship Dam
Manilla
Flaming Gorge
Wendover
S.L.C. A.P.
Salt Air
Moon Lake
Tooele
Heber
Vernal A.P.
Fort Duchesne
Dugway
Utah Lake
Provo A.P.
Strawberry Res.
Duchesne
Elberta
Partoun
Scofield Dam
Price
Levan
Moroni
Delta
Manti
Scipio
Castle Dale
Garrison
Fillmore
Salina
Green River
Emery
Richfield
Moab
Milford
Marysvale
Piute Dam
Loa
Hanksville
Beaver
Monticello
Boulder
Modena
Cedar City P.H.
Panguich
Escalante
Hite
Tropic
Blanding
Alton
Bluff
Zion N.P.
St. George
Kanab
Mexican Hat
3.00
4.00
5.00
6.00
7.00
60
80
100
120
140

Map 2:

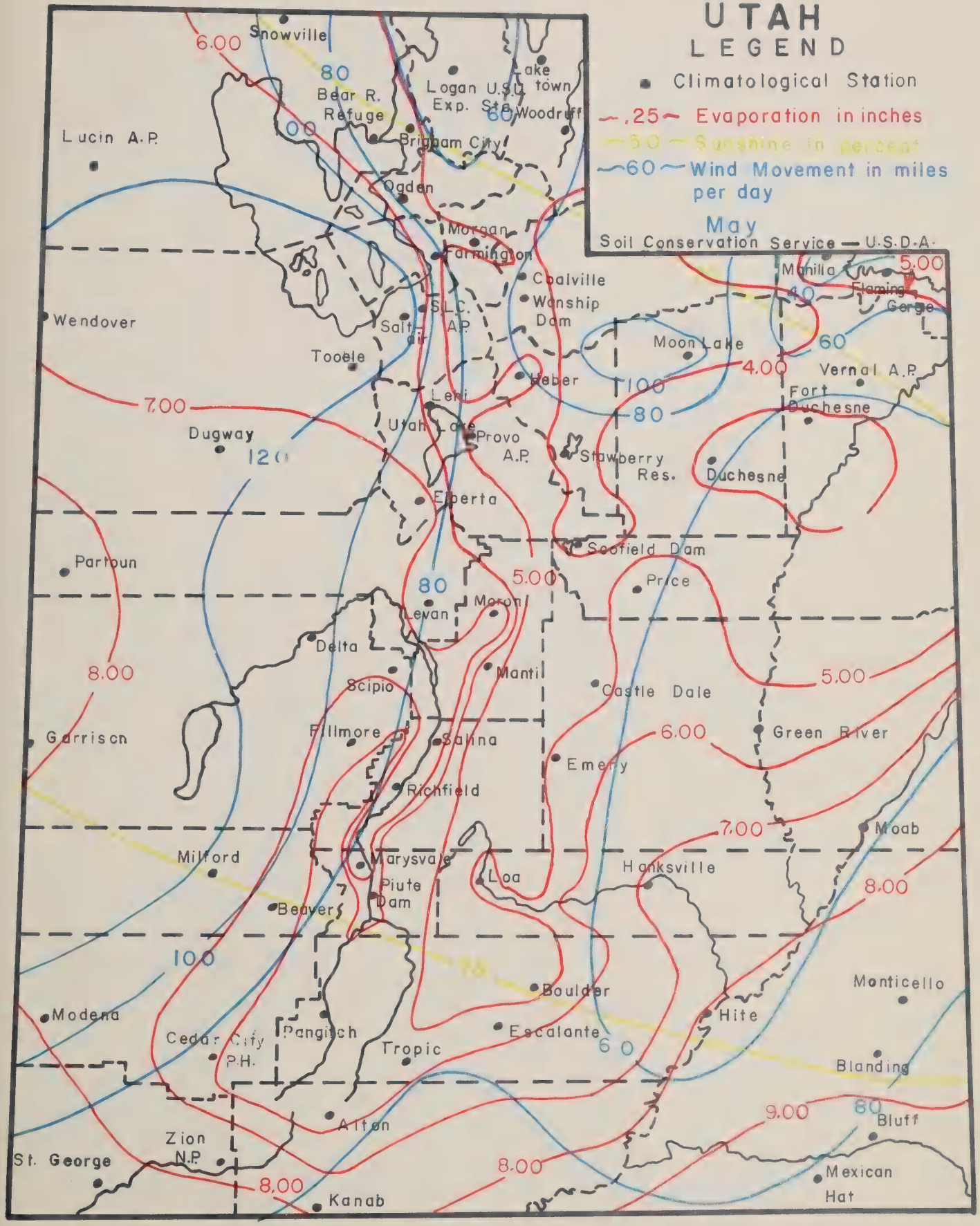
UTAH

LEGEND

- Climatological Station
- ~.25~ Evaporation in inches
- ~50~ Sunshine in percent
- ~60~ Wind Movement in miles per day

May

Soil Conservation Service — U.S.D.A.



Map 2:

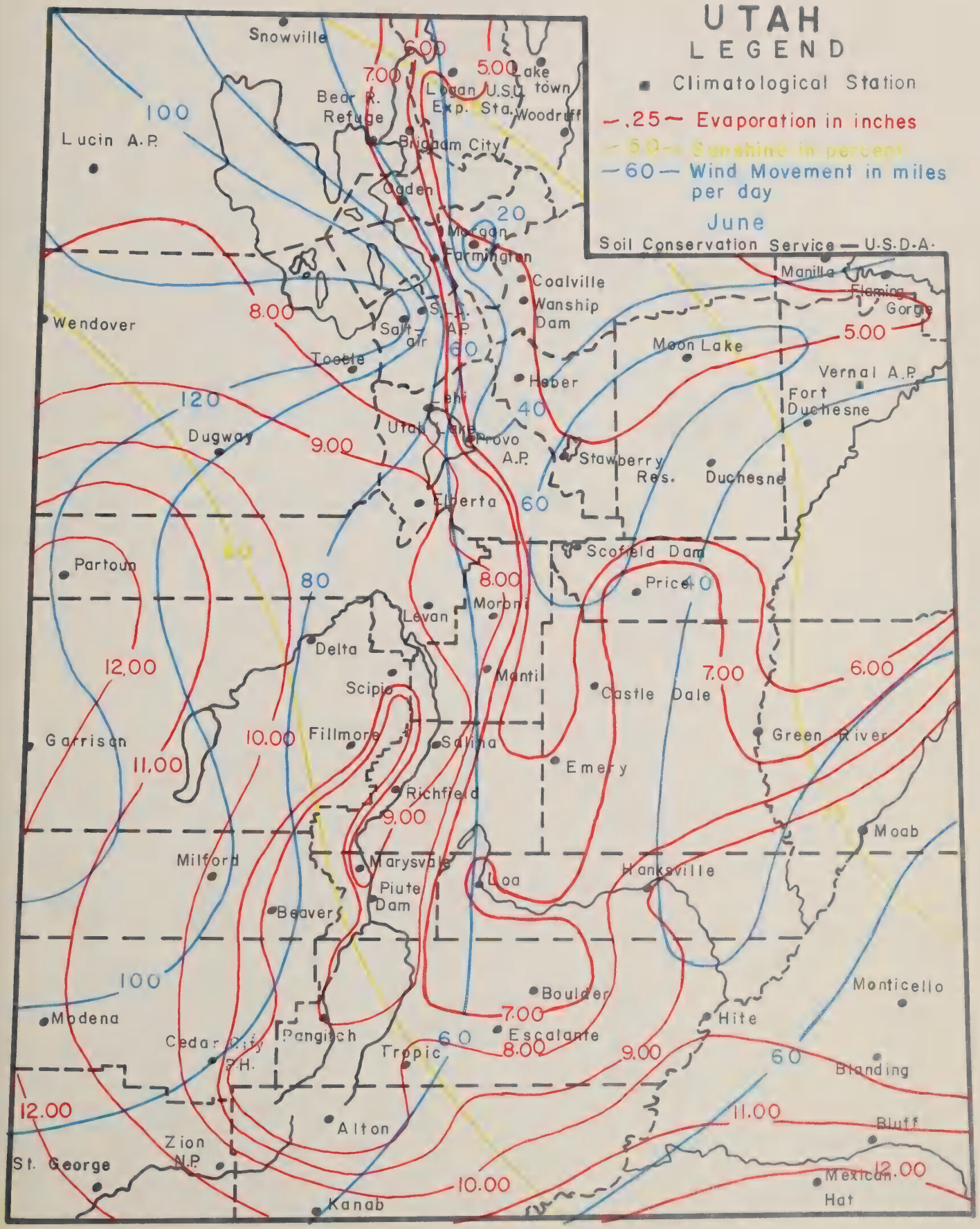
UTAH

LEGEND

- Climatological Station
- .25 — Evaporation in inches
- 50 — Sunshine in percent
- 60 — Wind Movement in miles per day

June

Soil Conservation Service — U.S.D.A.



Map 2:

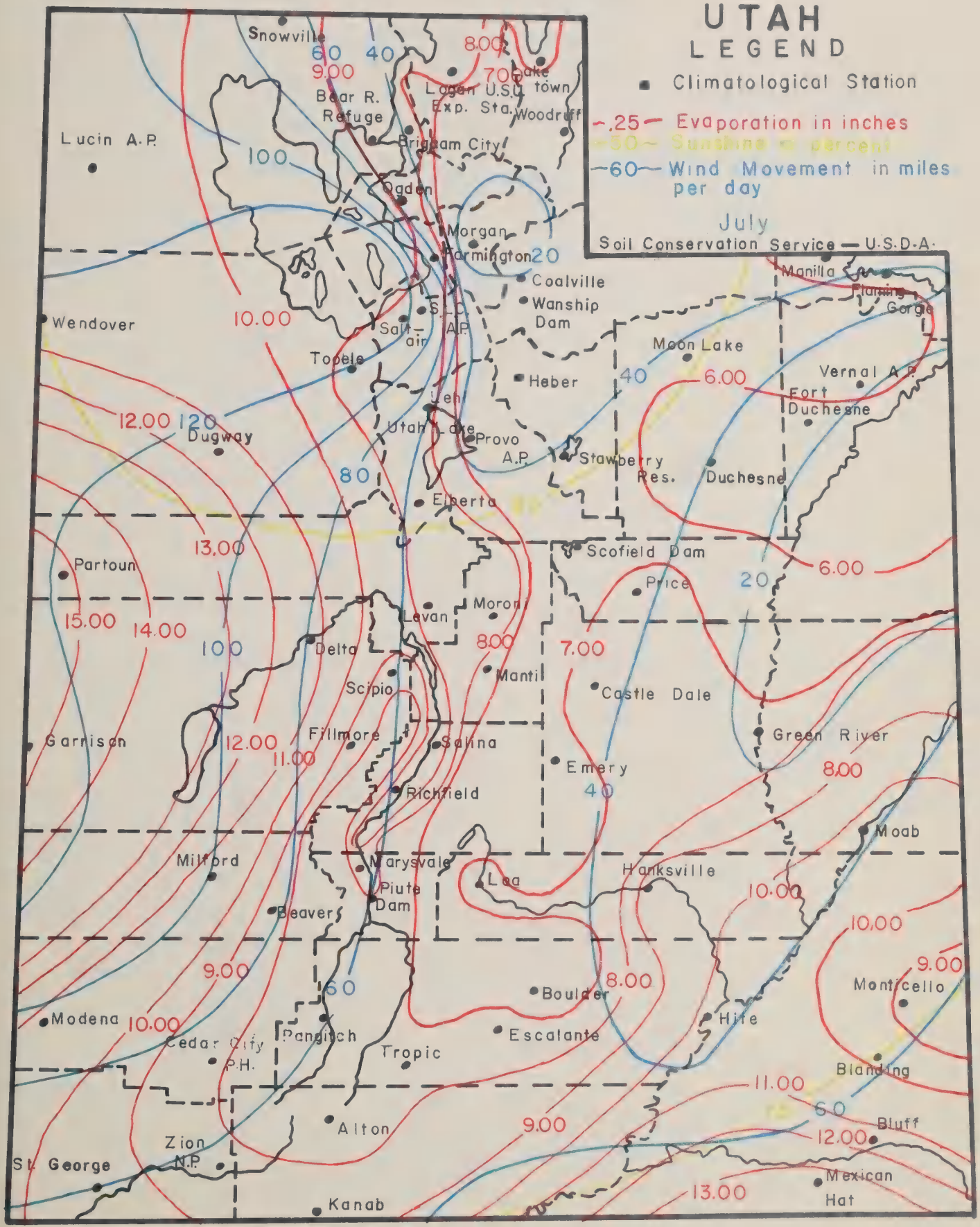
UTAH

LEGEND

- Climatological Station
- .25 Evaporation in inches
- 50 Sunshine in percent
- 60 Wind Movement in miles per day

July

Soil Conservation Service — U.S.D.A.



Map 2:

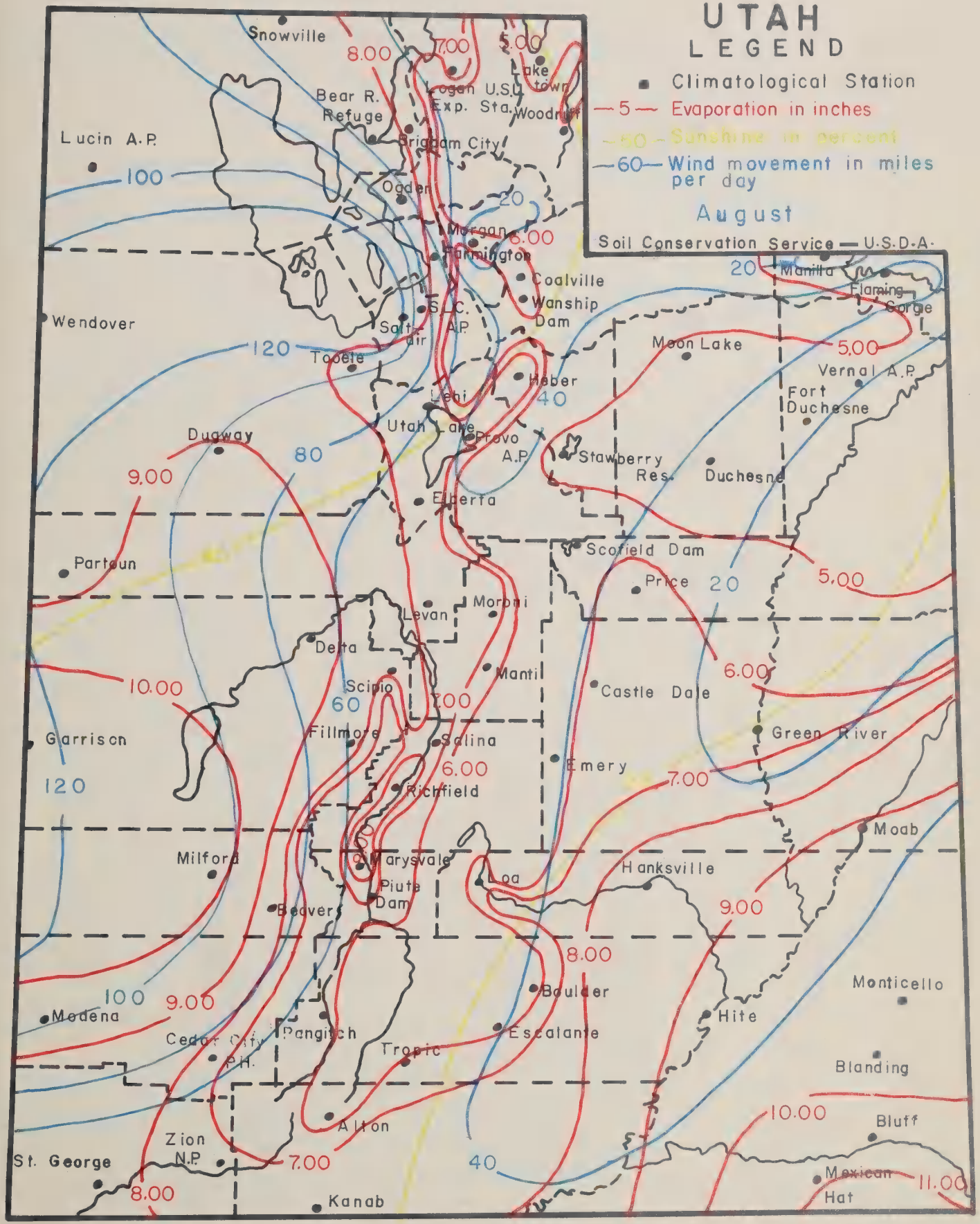
UTAH

LEGEND

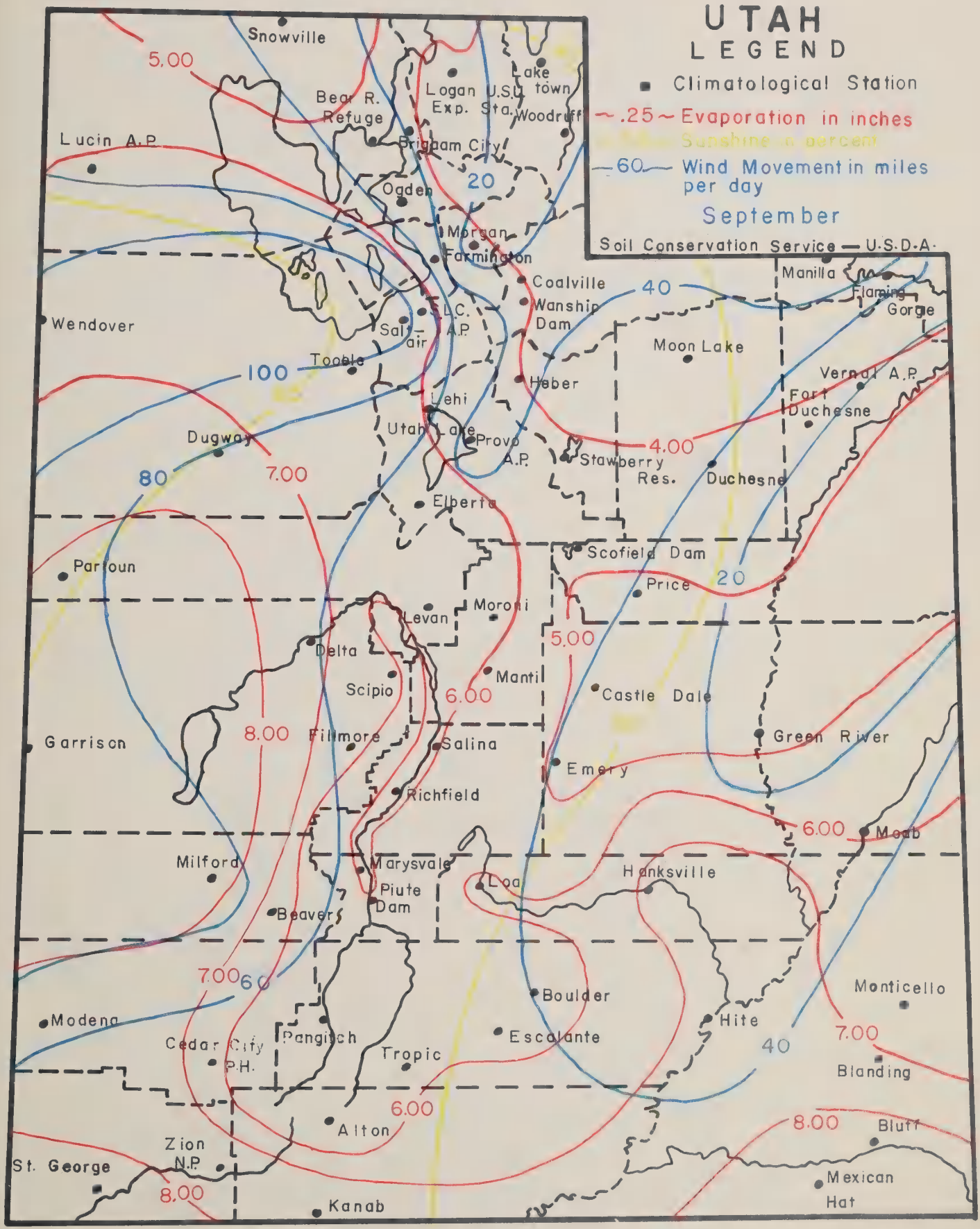
- Climatological Station
- —5— Evaporation in inches
- —50— Sunshine in percent
- —60— Wind movement in miles per day

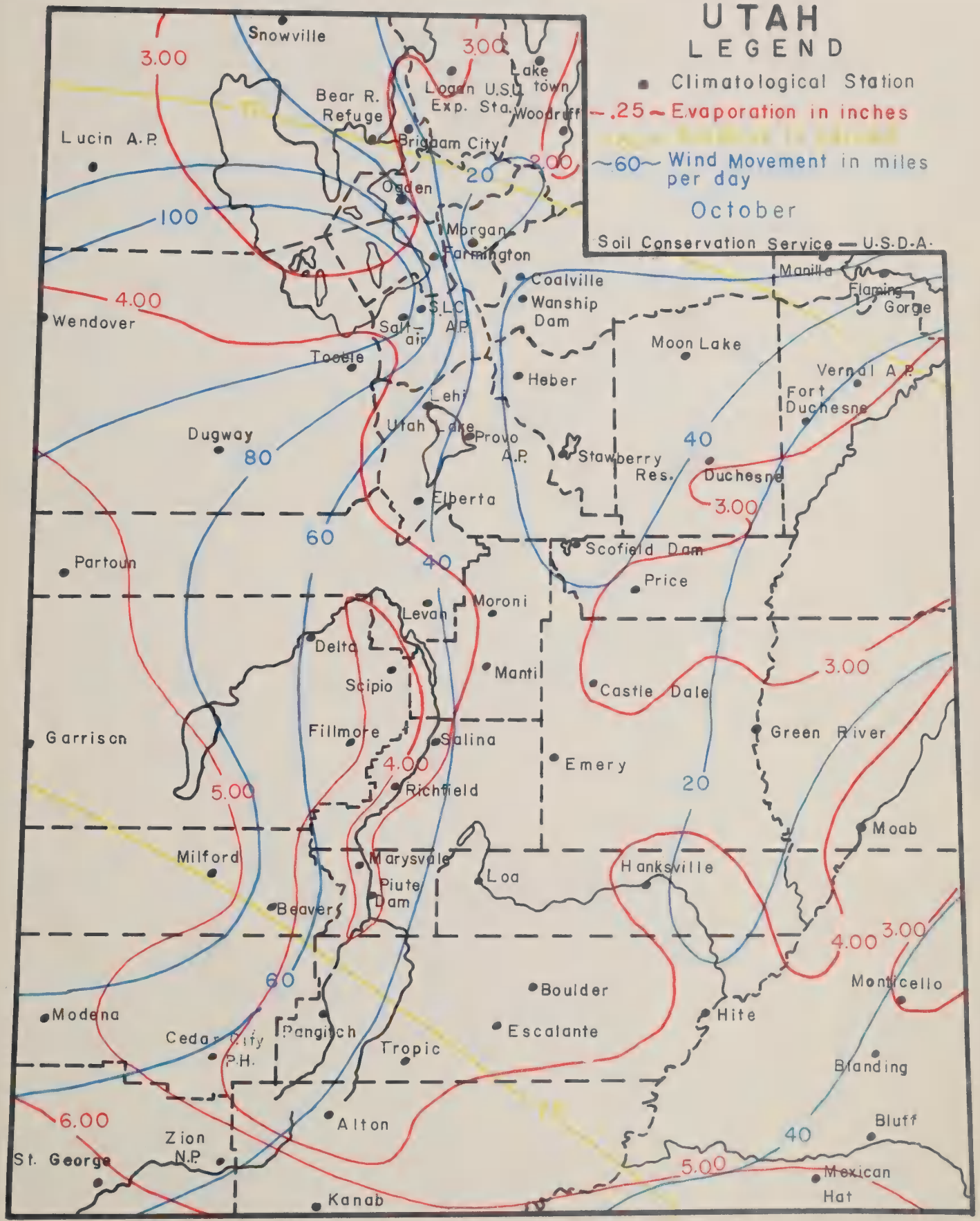
August

Soil Conservation Service — U.S.D.A.



Map 2.


UTAH
LEGEND
Climatological Station
~.25~ Evaporation in inches
Sunshine in percent
~60~ Wind Movement in miles per day
September
Soil Conservation Service — U.S.D.A.
Snowville
Bear R. Refuge
Logan U.S.U. Exp. Sta.
Lake town
Woodruff
Brigham City
Lucin A.P.
Ogden
Morgan
Farmington
Coalville
Wanship Dam
Manilla
Flaming Gorge
Wendover
Salt Air
S.L.C. A.P.
Moon Lake
Tooele
Heber
Vernal A.P.
Fort Duchesne
Lehi
Utah Lake
Provo A.P.
Stawberry Res.
Duchesne
Dugway
Elberta
Scofield Dam
Parfoun
Price
Levan
Moroni
Delta
Scipio
Manti
Castle Dale
Garrison
Fillmore
Salina
Green River
Emery
Richfield
Moab
Milford
Marysvale
Piute Dam
Loa
Hanksville
Beaver
Boulder
Monticello
Modena
Cedar City
P.H.
Panguitch
Escalante
Hite
Tropic
Blanding
Alton
Bluff
Zion N.P.
St. George
Mexican Hat
Kanab
5.00
20
40
100
80
7.00
4.00
6.00
8.00
60


Map 2:
UTAH
LEGEND
Climatological Station
.25 Evaporation in inches
60 Wind Movement in miles per day
October
Soil Conservation Service — U.S.D.A.
Snowville
Lucin A.P.
Bear R. Refuge
Logan U.S.U.
Exp. Sta.
Lake town
Woodruff
Brigham City
Ogden
Morgan
Farmington
Wendover
Salt Air
S.L.C. A.P.
Tooele
Coalville
Wanship Dam
Manila
Flaming Gorge
Moon Lake
Vernal A.P.
Fort Duchesne
Heber
Lehi
Utah Lake
Provo A.P.
Dugway
Stawberry Res.
Duchesne
Elberta
Scofield Dam
Price
Partoun
Moroni
Levan
Delta
Scipio
Manti
Castle Dale
Green River
Garrison
Fillmore
Salina
Emery
Richfield
Moab
Milford
Marysvale
Piute Dam
Loa
Hanksville
Beaver
Boulder
Monticello
Modena
Cedar City
P.H.
Panguich
Tropic
Escalante
Hite
Blanding
Alton
Bluff
Zion N.P.
St. George
Kanab
Mexican Hat
3.00
2.00
20
100
4.00
80
60
40
5.00
6.00

Map 2:

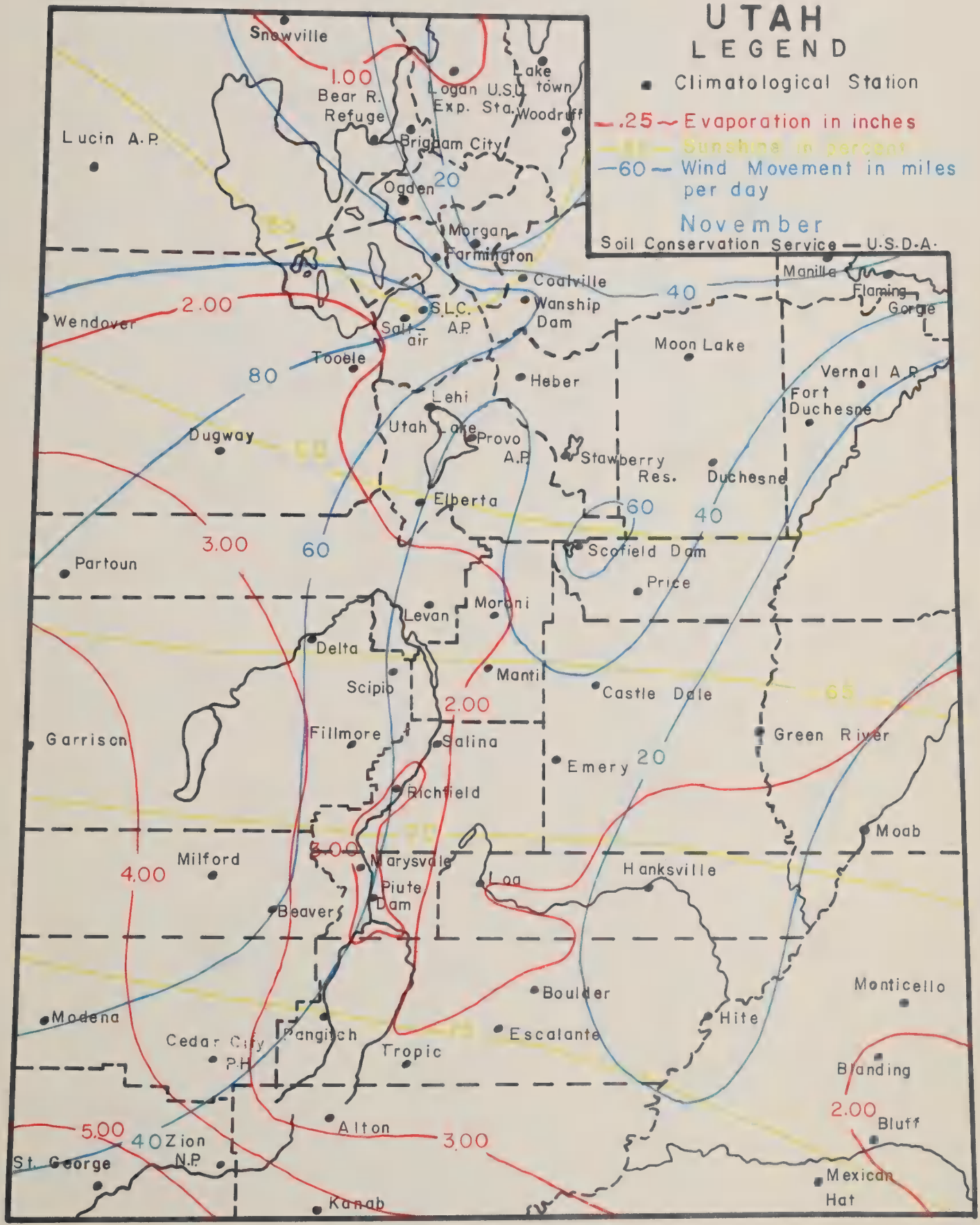
UTAH

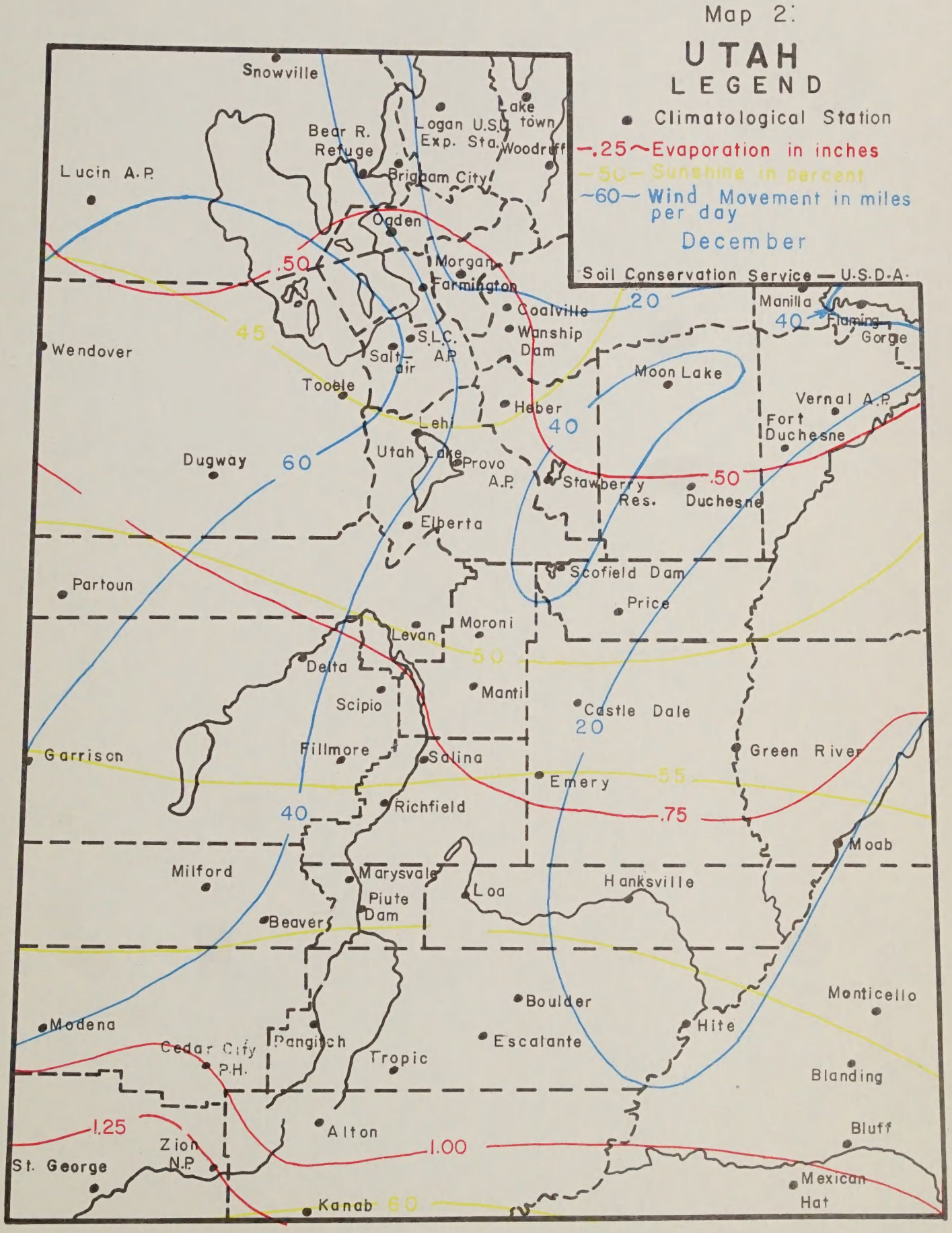
LEGEND

- Climatological Station
- .25 — Evaporation in inches
- 60 — Wind Movement in miles per day

November

Soil Conservation Service — U.S.D.A.




Map 2:
UTAH
LEGEND
Climatological Station
-.25~Evaporation in inches
-50-Sunshine in percent
~60~ Wind Movement in miles per day
December
Soil Conservation Service — U.S.D.A.
Snowville
Bear R. Refuge
Logan U.S.U. Exp. Sta.
Lake town
Woodruff
Lucin A.P.
Brigham City
Ogden
Morgan
Farmington
Coalville
Wanship Dam
S.L.C. A.P.
Salt Air
Wendover
Tooele
Heber
Lehi
Utah Lake
Provo A.P.
Dugway
Elberta
Partoun
Levan
Moroni
Delta
Scipio
Manti
Fillmore
Salina
Garrison
Richfield
Milford
Marysvale
Piute Dam
Beaver
Loa
Modena
Cedar City P.H.
Panguitch
Tropic
Alton
Zion N.P.
St. George
Kanab
Boulder
Escalante
Hanksville
Hite
Manilla
Flaming Gorge
Moon Lake
Vernal A.P.
Fort Duchesne
Stawberry Res.
Duchesne
Scofield Dam
Price
Castle Dale
Green River
Emery
Moab
Monticello
Blanding
Bluff
Mexican Hat
.50
45
60
40
20
50
55
.75
1.25
1.00